Claims

1. A lens structure for a directional display apparatus, comprising

a birefringent lens array capable of directing light of a given polarisation into a directional distribution, the birefringent lens comprising a solid, first birefringent material and an isotropic material having an interface having a refractive structure;

a second birefringent material arranged adjacent the first birefringent material of the birefringent lens, wherein the interface between the first birefringent material and the second birefringent material has an alignment microstructure providing alignment of the first birefringent material and the second birefringent material.

2. A lens structure according to claim 1, wherein the second birefringent material is switchable to control the polarisation of light passing through the lens structure.

3. A lens structure according to claim 2, wherein the second birefringent material is a switchable liquid crystal layer capable of rotating the polarisation of light passing therethrough.

4. A lens structure according to any one of the preceding claims, wherein said refractive structure is uniform in one direction and said alignment microstructure at the interface between the first birefringent material and the second birefringent material provides alignment in the direction of polarisation of a polarisation component polarised in said one direction at said interface between the first birefringent material and the isotropic material.

5. A lens structure according to any one of the preceding claims, wherein said interface between the first birefringent material and the isotropic material of the birefringent lens has an alignment microstructure providing alignment of the first birefringent material.

6. A lens structure according to claim 5, wherein said refractive structure is uniform in one direction and said alignment microstructure at the interface between the first birefringent material and the isotropic material of the birefringent lens provides alignment in said one direction.

7. A lens structure according to any one of the preceding claims, wherein the first birefringent material has at least one integrally formed spacer for spacing the thickness of the second birefringent material.

8. A lens structure according to any one of the preceding claims, wherein said alignment microstructure between the first birefringent material and the second birefringent material is a surface relief microstructure.

9. A lens structure according to any one of claims 1 to 7, wherein said alignment microstructure between the first birefringent material and the second birefringent material is a rubbed polyimide layer.

10. A directional display device comprising:

a spatial light modulator comprising an array of pixels; and

a lens structure according to any one of the preceding claims arranged to receive light from the pixels of the spatial light modulator.

11. A birefringent lens comprising:

a birefringent material and an isotropic material having an interface having a refractive structure and a surface relief alignment microstructure providing alignment of the birefringent material, wherein the refractive index of the isotropic material is substantially equal to the extraordinary refractive index of the birefringent material.

12. A birefringent lens according to claim 11, wherein the surface of the birefringent material on the opposite side from the isotropic material has an alignment microstructure providing alignment of the birefringent material in the same direction with respect to a given polarisation component as the alignment provided by the alignment microstructure with respect to the given polarisation component at the interface between the birefringent material and the isotropic material.

13. A birefringent lens according to claim 11 or 12, wherein the alignment microstructure has features with a dimension of the order of the wavelength of visible light or less.

14. A birefringent lens according to any one of claims 11 to 13, wherein the birefringent lens is a lens array.

15. A birefringent lens according to claim 14, wherein said refractive structure of said interface between the birefringent material and the isotropic material is shaped to direct light of a polarisation component parallel to the ordinary axis of the birefringent material into a directional distribution.

16. A directional display device comprising:

a spatial light modulator comprising an array of pixels; and

a birefringent lens according to claim 15 arranged to receive light from the pixels of the spatial light modulator; and

a polarisation control arrangement arranged to control the polarisation of light passing through the device to switch the output light between polarisation components corresponding to polarisation components at the birefringent lens parallel to the ordinary and extraordinary axes of the birefringent material.

17. A lens structure for a directional display apparatus, comprising:

a birefringent lens array capable of directing light of a given polarisation into a directional distribution;

a switchable liquid crystal layer capable of rotating the polarisation of light passing therethrough;

a pair of electrodes for applying an electric field to switch the liquid crystal layer, the electrodes being arranged with both the birefringent lens array and the switchable liquid crystal layer therebetween, the material of the birefringent lens array having an electrically conductive material incorporated therein.

18. A lens structure according to claim 16, wherein the conductive material is a conductive polymer.